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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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04/09/2004

Min-Lung Huang

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EXAMINER

KALAM, ABUL

ART UNIT

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/820,856	<b>Applicant(s)</b> HUANG, MIN-LUNG	
	<b>Examiner</b> Abul Kalam	<b>Art Unit</b> 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 28 January 2008.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,3,7 and 20-26 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,3,7 and 20-26 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)          | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 102*

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

1. **Claims 1, 4 and 22** are rejected under 35 U.S.C. 102(b) as being anticipated by **Mis et al. (US 5,767,010; previously cited, hereinafter, Mis)**.

With respect to **claims 1 and 22**, **Mis** teaches (**FIGs. 5 and 6**) an under bump metallization structure applicable to be disposed on bonding pads (**24**) of a semiconductor wafer, wherein a passivation layer (**26**) covers the wafer and exposes the bonding pads, the under bump metallization structure comprising:

an adhesive layer (**28**) formed on the bonding pads (**24**);  
a first barrier layer (**30**) disposed on the adhesive layer (**28**);  
a wetting layer (**32**) formed on the first barrier layer (**30**) (**col. 4: Ins. 11-27**); and  
a second barrier layer (**34'**) disposed on the wetting layer (**32**) (**col. 5: Ins. 58-67**), wherein a material of the second barrier comprises tin-copper alloy (**Cu<sub>3</sub>Sn**; **col. 5: In. 65**), wherein the tin-copper alloy of the second barrier layer are not fully reacted with each other (**it is implicit that some portion of the copper layer 34 did not fully react**

**with the tin from the solder; col. 5: Ins. 63-65); and wherein the quantity of the copper is larger than that of tin ( $\text{Cu}_3\text{Sn}$ ) (col. 5: Ins. 58-67).**

With respect to **claim 4**, **Mis** teaches the structure of claim 1, as set forth above, wherein the wetting layer **(32)** is a copper layer (**col. 4: Ins. 21-27; chromium-copper is a copper alloy, and thus is considered a copper layer**).

2. **Claims 22 and 25** are rejected under 35 U.S.C. 102(e) as being anticipated by **Yeh et al. (US 2004/0035909**; newly cited, hereinafter, Yeh).

With respect to **claim 22**, **Yeh** teaches (**FIG. 1**) an under bump metallization structure applicable to be disposed on bonding pads **(16)** of a semiconductor wafer **(10)**, wherein a passivation layer **(22)** covers the wafer and exposes the bonding pads **(16)**, the under bump metallization structure **(20 and 24)** comprising:

an adhesive layer (**¶ [0009]: “Al” or “Cr”**) formed on the bonding pads **(24)**;  
a first barrier layer (**¶ [0009]: “NiV” or “CrCu”**) disposed on the adhesive layer;  
a wetting layer (**¶ [0009]: “Cu”**) formed on the first barrier layer; and  
a second barrier layer **(24, FIG. 1; ¶ [0019])** disposed on the wetting layer,  
wherein a material of the second barrier comprises tin-copper alloy (**¶ [0023]: “CuSn”**),  
wherein the tin-copper alloy of the second barrier layer are not fully reacted with each other (**¶ [0023]: “sufficient amount of copper above the eutectic level such that CuSn IMC’s precipitate out to form IMC layer 24”**), and wherein the quantity of the copper is larger than that of tin (**¶ [0023]: “copper-rich IMC layer 24”**).

With respect to **claim 25**, **Yeh** teaches wherein the first barrier layer is NiV and the wetting layer is Cu (**¶ [0024]: “Al--NiV--Cu”**).

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. **Claims 3 and 24-26** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Mis ('010)**, as applied above to claims 1 and 22, respectively, and further in view of **Michael (US 5,563,102; previously cited)**.

With respect to **claims 3, 24 and 25**, **Mis** teaches all the limitations of claims, as set forth above, including wherein the wetting layer (**32**) is a copper layer (**col. 4: Ins. 21-27; chromium-copper is a copper alloy, and thus is considered a copper layer**).

However, **Mis** does not disclose a first barrier layer of nickel-vanadium, as claimed. Instead, **Mis** teaches that the first barrier layer (**30, FIG. 6**) is formed of chromium (**col. 3: Ins. 11-27**). However, **Michael** teaches that a barrier layer may formed of materials such as nickel-vanadium or chromium (**col. 9: Ins. 9-15**). Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of **Michael** and **Mis**, to form the first barrier layer comprising nickel-vanadium, because such a modification is considered a mere substitution of art recognized equivalent materials (MPEP 2144.06).

Substitution of equivalents requires no express motivation as long as the prior art recognizes the equivalency. *In re Fount* 213 USPQ 532 (CCPA 1982); *In re Siebentritt* 152 USPQ 618 (CCPA 1967); *Graver Tank & Mfg. Co. Inc. v. Lindle Air Products Co.* 85 USPQ 328 (USSC 1950).

With respect to **claim 26, Mis and Michael** teach all the limitations of the claim, as set forth above in claim 25, with the exception of disclosing: wherein the thickness of the second barrier layer is ranged from about 50µm to 80µm.

However, it has been held that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover optimum or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 105 USPQ 233, 234 (CCPA 1955). Furthermore, where patentability is said to be based upon a particular chosen range or dimension recited in a claim, the Applicant must show that the chosen range or dimension is critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have a thickness of the second barrier layer in such a range as claimed, because the range is not critical since it can be optimized during routine experimentation, depending upon the conductivity desired for the second barrier layer.

4. **Claims 7, 20, 21 and 23** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Mis ('010)**, as applied above to claims 1 and 22, respectively.

With respect to **claims 7 and 23**, **Mis** teaches all the limitations of the claims, as set forth above, with the exception of disclosing: wherein the thickness of the second barrier layer is ranged from about 50 $\mu$ m to 80 $\mu$ m.

However, it has been held that where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover optimum or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 105 USPQ 233, 234 (CCPA 1955). Furthermore, where patentability is said to be based upon a particular chosen range or dimension recited in a claim, the Applicant must show that the chosen range or dimension is critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have a thickness of the second barrier layer in such a range as claimed, because the range is not critical since it can be optimized during routine experimentation, depending upon the conductivity desired for the second barrier layer.

With respect to **claim 20**, **Mis** teaches all the limitations of the claim, as set forth above in claim 1, including wherein the second barrier layer (**34'**, **FIG. 6**) comprises tin and copper. However, **Mis** does not disclose wherein the tin and copper are present in the second barrier layer at the time of disposing the second barrier layer on the wetting layer. The phrase "at the time of disposing the second barrier layer on the wetting layer," recites a product by process limitation, and thus, is not given patentable weight. Note that a "product by process" claim is directed to the product per se, no matter how actually made. *In re Thorpe et al.*, 227 USPQ 964, (CAFC, 1985) and the related case

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law cited therein which makes it clear that it is the final product per se which must be determined in a “product by process” claim, and not the patentability of the process, and that, as here, an old or obvious product produced by a new method is not patentable as a product, whether claimed in “product by process” claims or not. As stated in Thorpe:

Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935);

**Note that Applicant has burden of proof in such cases** as the above case law makes it clear.

With respect to **claim 21**, **Mis** teaches all the limitations of the claim, as set forth above in claim 1, including further comprising a solder bump (**42, FIG. 6**), wherein the solder bump comprises tin (**col. 5: Ins. 43-45**). Thus, **Mis** teaches all the limitations of the claim with the exception of disclosing, wherein the tin of the second barrier layer is not from the tin of the solder bump. However, such a limitation is not considered critical to the invention. It does not matter if the tin in second barrier layer is from the solder bump, the device would still possess the same utility as Applicant's claimed structure. Furthermore, Applicant has not disclosed that the limitation is for a particular unobvious purpose, produces an unexpected result, or are otherwise critical, and thus, it appears that the device would possess the same utility without such a limitation. Indeed, it has been held that non-critical limitations are *prima facie* obvious, absent a disclosure that the limitations are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical. See, for example, *In re Rose*, 220 F.2d 459, 105 USPQ 237



(CCPA 1955); *In re Rinehart*, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984); *In re Dailey*, 357 F.2d 669, 149 USPQ 47 (CCPA 1966). See also MPEP 2144.04(IV)(B).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to form the structure, as claimed, because the limitation is not critical, and the device would possess the same utility without the limitation.

### ***Response to Arguments***

5. Applicant's arguments filed on January 28, 2008, have been fully considered but they are not persuasive.

Applicant argues that the  $\text{Cu}_3\text{Sn}$  intermetallic compound, disclosed by Mis (col. 5: ln. 65), "is not only chemically different from copper and tin, but also different from the tin-copper alloy." The argument is not persuasive. The  $\text{Cu}_3\text{Sn}$  intermetallic compound comprises both copper (Cu) and tin (Sn). Furthermore, the  $\text{Cu}_3\text{Sn}$  intermetallic compound is a tin-copper or copper-tin alloy, because an alloy is simply a compound that contains metal. Furthermore, Suzuki et al. (US 2003/0186597) discloses that  $\text{Cu}_3\text{Sn}$  intermetallic compound is a type of copper-tin alloy (¶ [0026]).

Applicant also argues that "Tin and Copper of the second barrier layer are not fully reacted with each other, and the quantity of copper is larger than that of tin so as to prevent discontinuous blocks (intermetallic compound) from forming in the first barrier layer of the under bump metallization structure." The argument is not persuasive because Mis teaches wherein tin and copper of the second barrier layer are not fully

reacted with each other (col. 5, ln. 63: "the solder reacts with a portion of the copper"), and wherein the quantity of copper is less than the quantity of tin (col. 5, ln. 65:  $\text{Cu}_3\text{Sn}$ ). The limitation, "to prevent discontinuous blocks (intermetallic compound) from forming in the first barrier layer," is not recited in the claims. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). Furthermore, the limitation is drawn to a function rather than the structure, and it has been held that an apparatus must be distinguished from the prior art in terms of structure rather than function. *In re Schreiber*, 128 F.3d 1473, 1477-78, 44USPQ2d 1429, 1431-32 (Fed. Cir. 1997).

Applicant also argues that "in claim 22 of the present invention, the second barrier layer is tin-copper alloy, and  $\text{Cu}_3\text{Sn}$  of the Mis reference is not the same with the tin-copper alloy." The argument is not persuasive, because the  $\text{Cu}_3\text{Sn}$  intermetallic of the Mis reference is considered a tin-copper alloy (US 2003/0186597: ¶ [0026]). Furthermore, it is noted that the arguments of counsel cannot take the place of evidence in the record. *In re Schulze*, 346 F.2d 600, 602, 145 USPQ 716, 718 (CCPA 1965); *In re Geisler*, 116 F.3d 1465, 43 USPQ2d 1362 (Fed. Cir. 1997). Attorney statements are not evidence and must be supported by an appropriate affidavit or declaration. See MPEP 716.01(c). The examiner recognizes that a  $\text{Cu}_3\text{Sn}$  intermetallic compound is a tin-copper alloy because the compound contains both copper (Cu) and tin (Sn). Therefore, if Applicant still believes that a  $\text{Cu}_3\text{Sn}$  intermetallic compound is not a tin-copper alloy, then Applicant is requested to support that position with facts.

***Conclusion***

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Abul Kalam whose telephone number is (571)272-8346.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you

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have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/A. K./

/Phat X Cao/  
Primary Examiner, Art Unit 2814